

1    I CLAIM:

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3                    1.    Endothermic catalytic reaction apparatus  
4    comprising:

5                    a)    a U-shaped flow through tubular reaction  
6    chamber disposed upright within a combustion chamber,  
7    and a catalyst contained within said reaction chamber  
8    for the conversion of hydrocarbon to industrial gases  
9    by reaction with steam; said reaction chamber having an  
10   upper portion, and there being a convection chamber  
11   extending about said upper portion to enhance the  
12   transfer of heat from combustion products in the  
13   reaction chamber, and

14                   b)    a radiant burner generally vertically  
15   disposed within the combustion chamber and having a gas  
16   permeable zone that promotes the flameless combustion  
17   of fuel and oxidant supplied to said burner in order to  
18   heat a metal fiber surface of the burner to  
19   incandescence for radiating heat to the reaction  
20   chamber; said radiant burner configured so that the  
21   angle of radiation is predominantly incident upon the  
22   surface of the tubular reaction chamber.

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1           2.    The combination of claim 1 wherein said  
2   tubular reaction chamber comprises a tube having outer  
3   diameter or diameters ranging from about  $\frac{3}{4}$  inch to  
4   about 4 inches along the tube length.

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7           3.    The combination of claim 1 wherein said  
8   tubular reaction chamber is sized for creation of mass  
9   velocities ranging from 400 lb/ft<sup>2</sup>/h to 1500 lb/ft<sup>2</sup>/h.

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12           4.    The combination of claim 1 wherein said  
13   catalyst in the tubular reaction chamber has average  
14   catalyst particle diameters ranging from 1/8 to 1 inch  
15   for producing gas pressure drops ranging from 1 psi to  
16   8 psi during flow through the reaction chamber.

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19           5.    The combination of claim 1 wherein said  
20   tubular reaction chamber has a gas exit end temperature  
21   ranging from 1150°F to 1400°F when heated by said  
22   radiant burner, in operation.

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1           6.    The combination of claim 1 wherein said  
2   tubular reaction chamber has legs and an arc-shaped  
3   bend connecting said legs, and said legs and bend have  
4   maximum tube wall temperatures ranging from 1300°F to  
5   1600°F when heated by said radiant burner, in  
6   operation.

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9           7.    The combination of claim 1 wherein said  
10   tubular reaction has average heat fluxes ranging from  
11   3,000 btu/ft<sup>2</sup>/h to 10,000 btu/ft<sup>2</sup>/h, when heated by  
12   said radiant burner in operation.

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15           8.    The combination of claim 1 wherein said  
16   tubular reaction chamber is sized to have capacity to  
17   generate hydrogen plus carbon monoxide product in  
18   volumetric quantities ranging from 50 SCFH to between  
19   500 and 1500 SCFH.

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22           9.    The combination of claim 1 wherein said  
23   radiant burner comprises a supported porous ceramic  
24   material having extended life at operating temperatures  
25   up to 2100°F.

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